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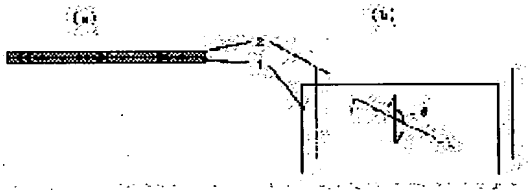
(54) POLARIZING ELEMENT, POLARIZING LIGHT SOURCE DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To form a polarizing light source with which linearly polarized light having a high degree of polarization and a small color change is obtainable via a quarter-wave plate with good conversion efficiency, light utilization efficiency is excellent and luminance is excellent and eventually a liquid crystal display device which is bright, is small in display unevenness and is excellent in visibility.
SOLUTION: This polarizing element is constituted by having at least the quarter- wave plate 1 on a circularly polarized light sepn. layer 1 consisting of one or ≥2 layers of cholesteric liquid crystal polymer layers. The average molecular alignment direction on the surface of the cholesteric liquid crystal polymer layers on the quarter- wave plate side of the circularly polarized light sepn. layer and the delay phase axial direction at the quarter-wave plate are in an intersecting state of 90 to 180° . The polarizing light source device has the polarizing element described above on the exit surface side of a light transmission plate for emitting the incident light from the flank from one of the front and rear surfaces. The liquid crystal display device is constituted by arranging the polarizing light source device on one side of a liquid crystal cell.



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[Claim(s)]
[Claim 1] The polarizing element characterized by coming at least to have a quarter-wave length plate on the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer, and being in the crossover condition that the direction of average molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer by the side of the quarter-wave length plate in the circular polarization of light detached core and the direction of a lagging axis in a quarter-wave length plate are 90 - 180 degrees.
[Claim 2] The polarizing element to which the direction of molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer by the side of a quarter-wave length plate is equal to an abbreviation one direction in claim 1.
[Claim 3] The polarizing element to which a quarter-wave length plate is located in a side with the main large wavelength of the reflected light in a circular polarization of light detached core in claim 1 or 2.
[Claim 4] The polarizing element to which it comes to form the main wavelength of the reflected light a circular polarization of light detached core in a less than 400-550nm cholesteric-liquid-crystal polymer and a 550 or more - 700nm cholesteric-liquid-crystal polymer in claims 1-3.
[Claim 5] The polarizing element whose overall thickness the total thickness of a cholesteric-liquid-crystal polymer layer is 2-500 micrometers in 1-50 micrometers in claims 1-4.
[Claim 6] The polarizing element which a circular polarization of light detached core becomes from the cholesteric-liquid-crystal polymer layer from which a spiral pitch changes in the thickness direction in claims 1-5.
[Claim 7] The polarizing element which has a polarizing plate above a quarter-wave length plate in claims 1-6.
[Claim 8] Polarization light equipment characterized by having a polarizing element according to claim 1 to 7 in the outgoing radiation side side of the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side.
[Claim 9] The liquid crystal display characterized by having arranged polarization light equipment according to claim 8 in one side of a liquid crystal cell.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the polarizing element which is excellent in polarization light equipment and brightness which are excellent in efficiency for light utilization, and can form the liquid crystal display of right visibility etc.
[0002]
[Background of the Invention] A reflecting layer is conventionally prepared in the underside of the light guide plate of the side light mold to which it was made to carry out outgoing radiation of the incident light from a side face from one side of a vertical side. Prepare the circular polarization of light detached core which consists of a cholesteric-liquid-crystal layer in an outgoing radiation side, and it separates into the transmitted light and the reflected light which consist of the circular polarization of light of right and left of incident light through the circular polarization of light detached core. The lighting system which is made to reflect the reflected light through a reflecting layer at the bottom, and was made to carry out re-outgoing radiation from an outgoing radiation side was proposed (JP,3-45906,A, JP,6-324333,A, JP,7-36032,A).
[0003] Since it is deficient in the light which about 55% of light guide plate outgoing radiation light is absorbed, and can be used effectively in case a polarizing plate is penetrated with the usually light of unpolarized light, as this lighting system can supply light as polarization, it prevents absorption by the polarizing plate, it aims at improvement in efficiency for light utilization by that cause, and raises the brightness of a liquid crystal display etc., and it deals in it.
[0004] In the above, absorption by the polarizing plate can be reduced more by making a quarter-wave

length plate penetrate and linearly-polarized-light-izing to the outgoing radiation circular polarization of light of a circular polarization of light detached core, and improvement in permeability can be aimed at. Therefore, what attached the quarter-wave length plate to the circular polarization of light detached core, and was used as the polarizing element can use for a liquid crystal display preferably.

[0005] However, when the quarter-wave length plate had been arranged to the circular polarization of light detached core, there was a trouble which produces the variation in brightness.

[0006]

[The technical technical problem of invention] this invention persons studied that the direction of orientation of a circular polarization of light detached core and an optical axis of a quarter-wave length plate were related to the variation in brightness, while repeating research wholeheartedly, in order to conquer the aforementioned trouble. Therefore, this invention makes a technical problem development of the polarizing element which is excellent in brightness and its stability.

[0007]

[Means for Solving the Problem] This invention comes at least to have a quarter-wave length plate on the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer. The polarizing element characterized by being in the crossover condition that the direction of average molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer by the side of the quarter-wave length plate in the circular polarization of light detached core and the direction of a lagging axis in a quarter-wave length plate are 90 - 180 degrees, And the polarization light equipment characterized by having the aforementioned polarizing element in the outgoing radiation side side of the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side, and the liquid crystal display characterized by having arranged the polarization light equipment in the list at one side of a liquid crystal cell are offered.

[0008]

[Effect of the Invention] According to the polarizing element of this invention, through a quarter-wave length plate, degree of polarization is high and color change can acquire the small linearly polarized light with sufficient conversion efficiency. Consequently, the polarization light equipment which is excellent in efficiency for light utilization using it, and is excellent in brightness, as a result the liquid crystal display which it is bright, and display nonuniformity is small, and is excellent in visibility can be formed.

[0009]

[Embodiment of the Invention] The polarizing element of this invention comes at least to have a quarter-wave length plate on the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer, and the direction of average molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer by the side of the quarter-wave length plate in the circular polarization of light detached core and the direction of a lagging axis in a quarter-wave length plate are in the crossover condition which is 90 - 180 degrees. The example was shown in drawing 1 and drawing 2 . 1 is a circular polarization of light detached core, 2 is a quarter-wave length plate, and, as for 11, 13, and 15, a support base material, and 12 and 14 are cholesteric-liquid-crystal polymer layers.

[0010] A circular polarization of light detached core can be formed using one sort of the proper cholesteric-liquid-crystal polymer which divides the natural light into the circular polarization of light on either side as the transmitted light and the reflected light by GURANJAN orientation, or two sorts or more. Therefore, various things, such as a principal chain mold with which the straight-line-like atomic group (meso gene) of the conjugate property which gives a liquid crystal stacking tendency was introduced into the principal chain and side chain of a polymer as a cholesteric-liquid-crystal polymer, and a side-chain mold, can be used.

[0011] The wavelength region of selective reflection becomes large and the larger cholesteric-liquid-crystal polymer of phase contrast can be used more preferably than points, such as allowances over the wavelength shift at the time of a large angle of visibility. Moreover, as a liquid crystal polymer, that whose glass transition temperature is 30-150 degrees C can use preferably from points, such as handling nature and the stability of the orientation in operating temperature.

[0012] It has the structure which combined the meso gene radical which minds the spacer section which gives flexibility if needed as an example of the liquid crystal polymer of the principal chain mold incidentally described above, and consists of a Para permutation ring compound etc., for example, polymers, such as a polyester system, a polyamide system, a polycarbonate system, and a polyester imide system, are raised.

[0013] Moreover, a thing, a nematic system liquid crystal polymer of low-molecular chiral agent content, a

liquid crystal polymer of chiral component installation, a mixed liquid crystal polymer of a nematic system and a cholesteric system, etc. which have the low-molecular-liquid-crystal compound (meso gene section) which makes polyacrylate, polymethacrylate, a polysiloxane, poly malonate, etc. a principal chain frame, minds the spacer section which consists of an atomic group of conjugate property as a side chain as an example of the liquid crystal polymer of a side-chain mold if needed, and consists of a Para permutation ring compound etc. are raised.

[0014] Like the above, it can consider as the thing of a cholesteric stacking tendency with the method which introduces the proper chiral component which consists of a compound which has asymmetrical carbon also in what has the Para permutation ring compound which gives the nematic stacking tendency which consists of the Para permutation aromatic-series unit, the Para permutation cyclohexyl ring unit, etc. like for example, an azomethine form, an azo form, an AZOKISHI form and an ester form, a biphenyl form and a phenylcyclohexane form, and a bicyclo hexane form, a low-molecular chiral agent, etc. (JP,55-21479,A, U.S. Pat. No. 5332522, etc.). In addition, a cyano group, the alkyl group, alkoxy group of the end substituent in the para position in the Para permutation ring compound, etc. may be proper.

[0015] Moreover, as the spacer section, for example, polymethylene chain-(CH2) n-, polyoxymethylene chain-(CH2CH2O) m-, etc. which show flexibility are raised. the chemical structure of the meso gene section etc. determines suitably the number of cycles of the structural unit which forms the spacer section -- having -- general -- the case of a polymethylene chain -- n -- 0-20, and the case where they are 2-12, and a polyoxymethylene chain above all -- m -- 0-10 -- it is 1-3 above all.

[0016] Formation of a circular polarization of light detached core for example, on a support base material Polyimide and polyvinyl alcohol, The orientation film which formed film, such as polyester, polyarylate and polyamidoimide, and polyether imide, and carried out rubbing processing with the rayon cloth etc., The proper orientation film which consists of a method vacuum evaporationo layer of slanting of SiO2 etc. is prepared. Or on the orientation film Or a cholesteric-liquid-crystal polymer is developed on the support base material of molecular orientation nature which consists of an oriented film etc. More than glass transition temperature, it can be heated under to isotropic phase transition temperature, and can be performed by the approach of cooling under to glass transition temperature, after the liquid crystal polymer molecule has carried out GURANJAN orientation, and making a vitreous state, and making it into the flozen layer by which the orientation concerned was fixed etc.

[0017] Proper things, such as a single layer material which consists of a transparent plastic film, a transparent glass plate, etc., and a multilayer material, can be used for the aforementioned support base material. About the plastics, there is especially no definition and it can be suitably chosen by the physical properties to which it responded like activity eyes, such as moisture resistance, thermal resistance, and reinforcement. Incidentally as an example of said plastics, the thing of the polyolefine system like polyethylene or polypropylene, a polyester system, a polyimide system, a polycarbonate system, a polyether sulphone system, a polysulfone system, a cellulose type, a polyarylate system, a polystyrene system, a polyvinyl alcohol system, a polyvinyl chloride system, a polyvinylidene chloride system, the Pori acrylic, a polyamide system, an epoxy system, and a liquid crystal polymer system etc. is raised.

[0018] Expansion of a liquid crystal polymer can carry out thin layer expansion of the solution by the solvent of a liquid crystal polymer by proper approaches, such as a spin coat method, the roll coat method, the flow coat method and the printing method, a dip coating method and the flow casting forming-membranes method, the bar coat method, and gravure, and can be performed by the approach of carrying out desiccation processing of it if needed etc. As the aforementioned solvent, proper things, such as a methylene chloride, a cyclohexanone and a trichloroethylene, tetrachloroethane and N-methyl pyrrolidone, and a tetrahydrofuran, can be used, for example.

[0019] Moreover, the heating melt of a liquid crystal polymer and the heating melt in the condition of presenting an isotropic phase preferably can be developed according to the above, and the approach which does not use solvents, such as an approach which develops to a thin layer and it is made to solidify further, maintaining the melting temperature if needed, therefore the health nature of work environment, etc. can develop a liquid crystal polymer also by the good approach.

[0020] Heat-treatment for carrying out orientation of the expansion layer of a liquid crystal polymer can be performed by heating to the temperature requirement from the glass transition temperature of a liquid crystal polymer to isotropic phase transition temperature, i.e., the temperature requirement where a liquid crystal polymer presents a liquid crystal phase, as described above. Moreover, immobilization of an orientation condition can be performed by cooling under to glass transition temperature, and there is especially no definition about the cooling condition. Usually, since the aforementioned heat-treatment can be performed at the temperature of 300 degrees C or less, generally a natural-air-cooling method is taken.

[0021] As for the cholesteric-liquid-crystal polymer layer to form, it is desirable to carry out orientation to

homogeneity as much as possible. Since the arrangement condition of a quarter-wave length plate is regulated especially in this invention in the direction of molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer of the side which prepares it, it is desirable that the orientation of a liquid crystal polymer is as much as possible uniform and that it is equal to the one direction with sufficient homogeneity in the aforementioned front face above all at least. The cholesteric-liquid-crystal polymer layer of homogeneity orientation offers the reflected light without dispersion, is advantageous to amplification of the angle of visibility of a liquid crystal display etc., and suitable for formation of the direct viewing type liquid crystal display by which direct observation is especially carried out also from across.

[0022] Attached to the support base material, it dissociates from a support base material and the cholesteric-liquid-crystal polymer layer formed on one side of a support base material or both sides can be used for formation of a circular polarization of light detached core. Moreover, there is one cholesteric-liquid-crystal polymer layer which forms a circular polarization of light detached core, and it may be more than two-layer. Therefore, the polarizing element of this invention may have a layer gestalt with the proper gestalt which does not have the gestalt or support base material which has the support base materials 11, 13, and 15 of a monolayer or a double layer in the proper location of the cholesteric-liquid-crystal polymer layers 1, 12, and 14 more than one layer or two-layer, as illustrated to drawing 1 (a) and drawing 2 (a) - (h).

[0023] In the above, formation of the circular polarization of light detached core by arrangement of the cholesteric-liquid-crystal polymer layer more than two-layer is aimed at amplification of a reflected wave length region etc. Namely, although a limitation is located in the wavelength region which shows selective reflection nature (circular dichroism) and the limitation also has usually the case of the large range which reaches about 100nm wavelength region in the cholesteric-liquid-crystal polymer layer of a monolayer Since it is less than the whole region of the light desired when applying to a liquid crystal display etc. also in the wavelength range It aims at making the wavelength region which prepares the cholesteric-liquid-crystal polymer layer more than two-layer [from which selective reflection nature (reflected wave length region) differs], and shows [like] circular dichroism the whole region of a light region thru/or when making the whole region into a reflected wave length region as much as possible expand. It is the combination which reflects the circular polarization of light of the same polarization direction, and the cholesteric-liquid-crystal polymer layer whose main wavelength of selective reflection is incidentally 300-900nm can be used in the combination from which the main wavelength of selective reflection differs, and the circular polarization of light detached core which can cover a light region by superimposing the 2-6 kinds can be formed efficiently.

[0024] What shows the target reflected wave length region with the small number of arrangement and the two-layer number of arrangement above all is as much as possible [a cholesteric-liquid-crystal polymer layer] more desirable than points; such as thin-shape-izing of a circular polarization of light detached core. Incidentally the whole region thru/or the circular polarization of light detached core which makes the whole region a reflected wave length region as much as possible can be obtained in a light region by arrangement of the two-layer cholesteric-liquid-crystal polymer layer which has the main wavelength of the reflected light in the range of less than 400-550nm and 550 or more - 700nm. The more desirable combination 450-540nm of 560-650nm of main wavelength of the reflected light is two-layer [with the range of 580-620nm, especially about 600nm thing] above all with the range which is 480-520nm above all, especially the thing which is about 500nm.

[0025] The combination of the above mentioned two-layer cholesteric-liquid-crystal polymer layer has the small, viewing-angle change, i.e., the color change by the outgoing radiation include angle of the slanting transmitted light, advantage etc. In addition, when preparing the three or more-layer cholesteric-liquid-crystal polymer layer from which a reflected wave length region differs, it is more desirable than the point which controls color change of the outgoing radiation light by said viewing-angle change to arrange in order of the wavelength based on the merits and demerits of the main wavelength of the reflected light.

[0026] In addition, it aims at loading of the polarization in the condition that it can prevent and use that the point made into combination although the circular polarization of light of the same polarization direction is reflected when arranging the cholesteric-liquid-crystal polymer layer more than two-layer [above mentioned] will be in a polarization condition which arranges the phase condition of the circular polarization of light reflected on each class, and is different in each wavelength region.

[0027] although a difference of the main wavelength of the reflected light in said cholesteric-liquid-crystal polymer carried out is based on a difference of the spiral pitch of clan JAN orientation -- this invention -- if -- you may be the circular polarization of light detached core of proper gestalten, such as a circular

polarization of light detached core from which a spiral pitch changes in the thickness direction, and a circular polarization of light detached core from which the cholesteric-liquid-crystal polymer layer more than two-layer [of a spiral pitch difference] is overlapped as the sequence of merits and demerits based on the main wavelength of the reflected light, and a spiral pitch changes in the thickness direction.

[0028] The above mentioned spiral pitch of the structure of changing in the thickness direction is also effective in amplification of the wavelength region of the reflected light etc. In that case, the layer system to which the cholesteric-liquid-crystal polymer layer from which a spiral pitch differs between the cholesteric-liquid-crystal polymer layers of the same spiral pitch contains the cholesteric-liquid-crystal polymer layer of the spiral pitch same like the thing of the gestalt which intervened one layer or more than two-layer more than two-layer as the sequence of the merits and demerits of said main wavelength is permitted.

[0029] In addition, manufacture of the circular polarization of light detached core from which the above-mentioned spiral pitch changes in the thickness direction For example, it applies to formation actuation of the cholesteric-liquid-crystal polymer layer described above on the cholesteric-liquid-crystal polymer layer which carried out orientation processing correspondingly. The method which carries out the sequential superposition of the cholesteric-liquid-crystal polymer layer, actuation of pasting up the predetermined number of two sheets or three sheets or more of cholesteric-liquid-crystal polymer layers which carried out orientation processing by thermocompression bonding, etc. can perform by performing expansion of a liquid crystal polymer, and its heating orientation processing.

[0030] In the case of the flozen layer of the liquid crystal polymer which consists of an one object with a base material, the polarizing element by the circular polarization of light detached core from which a spiral pitch changes in the thickness direction, as a result this invention can be obtained by carrying out superposition processing according to the above so that the flozen layers may be close. In addition, in thermocompression bonding processing, a method with the proper method which heats a cholesteric-liquid-crystal polymer layer under to isotropic phase transition temperature more than glass transition temperature, and carries out sticking-by-pressure processing through proper heating press means, such as a roll laminator, can be taken.

[0031] The circular polarization of light detached core from which a spiral pitch changes in the thickness direction may show the wavelength region of the continuous reflected light, and may show the wavelength region of the discontinuous reflected light. A circular polarization of light detached core more desirable than points, such as color nonuniformity prevention, shows the wavelength region of the continuous reflected light. The manufacture can heat the superposition object of the cholesteric-liquid-crystal polymer layer formed by the thermocompression bonding actuation described above, for example under to isotropic phase transition temperature more than glass transition temperature, and can be performed by the approach of forming the orientation layer which the cholesteric-liquid-crystal polymer which forms an up-and-down layer in the adhesion interface mixed etc.

[0032] The cholesteric-liquid-crystal polymer layer in which the cholesteric-liquid-crystal polymer of an up-and-down layer was mixed, and was formed in the above forms the circular polarization of light detached core from which the spiral pitch differed also from the up-and-down layer, and the spiral pitch changed to the multistage story in the thickness direction, and the spiral pitch takes the mean value of the cholesteric-liquid-crystal polymer layer which forms an up-and-down layer, and forms usually the field which shows the wavelength region of the reflected light which continued with the up-and-down layer.

[0033] Therefore, when it uses in the combination of the cholesteric-liquid-crystal polymer layer which the wavelength region of the reflected light does not overlap in an up-and-down layer, i.e., the combination in which the lack region discontinuously called at the wavelength region of the reflected light exists, the cholesteric-liquid-crystal polymer layer formed of mixing of an up-and-down layer can fill said lack region, and can continuation-ize the wavelength region of the reflected light.

[0034] Therefore, for example, a reflected wave length region means that the circular polarization of light detached core reflected using two sorts of cholesteric-liquid-crystal polymer layers, a thing 500nm [or less] and a thing 600nm or more, also about the light of the 500-600nm wavelength region which is the non-contiguous areas of a reflected wave length region can be obtained, and this can form the circular polarization of light detached core which is superposition of few cholesteric-liquid-crystal polymer layers, and shows the reflected wave length region of a wide band.

[0035] Especially the thickness of each cholesteric-liquid-crystal polymer layer has 1.5-10 micrometers more desirable than points, such as a size of turbulence of orientation, prevention of permeability lowering, and the wavelength range of the reflected light (reflected wave length region), 1-30 micrometers above all 0.5-50 micrometers. Moreover, it is more desirable than points, such as thin-shape-izing of a

circular polarization of light detached core, that 1-50 micrometers of 2-30 micrometers of total thickness of a cholesteric-liquid-crystal polymer layer are 3-10 micrometers especially above all.

[0036] As for especially the total thickness of the cholesteric-liquid-crystal polymer layer which furthermore includes a support base material, it is desirable that it is 20-200 micrometers 10-300 micrometers above all 2-490 micrometers. In addition, on the occasion of formation of a circular polarization of light detached core, the various additives which become a cholesteric-liquid-crystal polymer layer from a stabilizer, a plasticizer, or metals can be blended if needed.

[0037] Like the example of drawing, the polarizing element by this invention has the quarter-wave length plate 2 at least above the circular polarization of light detached core 1, and as the arrow head showed to drawing 1 (b), the direction of average molecular orientation in the front face of the cholesteric-liquid-crystal polymer layer by the side of the quarter-wave length plate in the circular polarization of light detached core and the direction of a lagging axis in a quarter-wave length plate are in the crossover condition which is 90 - 180 degrees. The crossed axes angle theta more desirable than points, such as brightness and color nonuniformity prevention, is 100 - 170 degrees.

[0038] The aforementioned quarter-wave length plate functions as a linearly polarized light conversion means, the circular polarization of light which carried out outgoing radiation from the circular polarization of light detached core carries out incidence to a quarter-wave length plate, a phase change is received, the light of the wavelength on which the phase change is equivalent to quarter-wave length is changed into the linearly polarized light, and other wavelength light is changed into elliptically polarized light. The changed elliptically polarized light turns into such flat elliptically polarized light that it is close to the wavelength of the light changed into the aforementioned linearly polarized light. Outgoing radiation of the light in the condition that many linearly polarized light components which may penetrate a polarizing plate are included will be carried out as a result of [this] a quarter-wave length plate.

[0039] By changing into a condition with many linearly polarized light components, it can consider as the light which is easy to penetrate a polarizing plate. In the case of a liquid crystal display, this polarizing plate functions as the optical layer which prevents lowering of the polarization property generated in change of the angle of visibility to a liquid crystal cell, and maintains display grace, an optical layer which realizes more advanced degree of polarization and attains better display grace.

[0040] That is, in the above, although it is possible to carry out incidence of the outgoing radiation polarization [detached core / circular polarization of light] to a liquid crystal cell as it is, and to attain a display, without using a polarizing plate, since improvement in the display grace described above by minding a polarizing plate etc. can be aimed at, a polarizing plate is used if needed. In that case, it is so more advantageous that the permeability to a polarizing plate is high than the point of the brightness of a display, and since the permeability becomes so high that many linearly polarized light components of the polarization direction which is in agreement with the polarization shaft (transparency shaft) of a polarizing plate are included, outgoing radiation polarization [detached core / circular polarization of light] is changed into the predetermined linearly polarized light through a linearly polarized light conversion means for the purpose of it.

[0041] The liquid crystal display which can obtain the permeability which exceeds 80% when a polarization shaft is made in agreement and incidence of the linearly polarized light is carried out, therefore whose utilization effectiveness of light improves substantially, and is incidentally excellent in brightness although the permeability is about 43% when incidence of the natural light or the circular polarization of light is carried out to a usual iodine system polarizing plate becomes possible. Moreover, in this polarizing plate, the degree of polarization which reaches to 99.99% can also be attained. If independent, achievement of this high degree of polarization is difficult, and the degree of polarization especially to the incident light from slant which is a circular polarization of light detached core tends to fall.

[0042] As a quarter-wave length plate, what is equivalent to the phase contrast of quarter-wave length in the circular polarization of light which carried out outgoing radiation, many linearly polarized lights are formed, and has the major-axis direction in the parallel direction as much as possible with said linearly polarized light, and can change the light of other wavelength into the flat elliptically polarized light near the linearly polarized light is more desirable than a circular polarization of light detached core. With this quarter-wave length plate, it can arrange so that the direction of the linearly polarized light of the outgoing radiation light and the major-axis direction of elliptically polarized light may be parallel as much as possible with the transparency shaft of a polarizing plate, and the light of a condition with many linearly polarized light components which may penetrate a polarizing plate can be obtained, and the brightness of a liquid crystal display can be raised.

[0043] The phase contrast given with a quarter-wave length plate can be suitably determined according to

the wavelength region of the circular polarization of light by which outgoing radiation is carried out etc. from a circular polarization of light detached core. Incidentally, from points, such as wavelength range and conversion efficiency, it also considers that it is that almost all the phase contrast plate indicates the wavelength dispersion of a forward birefringence to be from the construction material property, and a thing with the small phase contrast and the thing which gives 110-150nm phase contrast especially can use 100-180nm preferably above all in a light region.

[0044] A quarter-wave length plate can be formed with proper construction material, what gives transparent and uniform phase contrast is desirable, and, generally a phase contrast plate is used. Moreover, a quarter-wave length plate can be formed in drawing 1 (a) and drawing 2 (a) like instantiation as a superposition layer of the phase contrast layers 21 and 22 more than one layer or two-layer. In the case of the phase contrast layer which consists of one layer, a smaller thing can achieve equalization of the polarization condition for every wavelength, and its wavelength dispersion of a birefringence is desirable. On the other hand, superposition-izing of a phase contrast layer is effective in amelioration of the wavelength property in a wavelength region, and the combination may be suitably determined according to a wavelength region etc.

[0045] In addition, when considering as the quarter-wave length plate which consists of a phase contrast layer more than two-layer for a light region, it is more desirable than the point of obtaining the light in which the layer which gives 100-180nm phase contrast is included [of a linearly polarized light component] as odd one or more-layer layers in many cases, like the above. Although it is more desirable than points, such as amelioration of a wavelength property, to form in the layer which gives phase contrast 200nm or more usually, and the layer which gives 1/2 wave of phase contrast above all as for layers other than the layer which gives 100-180nm phase contrast, they are not limited to this. When a quarter-wave length plate consists of a phase contrast layer more than two-layer, the direction of a lagging axis at the time of arranging it on a circular polarization of light detached core is based on the phase contrast layer which gives 100-180nm phase contrast.

[0046] The above mentioned phase contrast plate can be obtained as an oriented film which consists of plastics illustrated with the above-mentioned support base material. It is so desirable that the error of the phase contrast within the field of a quarter-wave length plate is small, and it is more desirable than the point of maintaining luminescence reinforcement and the luminescent color to homogeneity with a large angle of visibility that the error is **10nm or less above all.

[0047] Although a quarter-wave length plate is arranged at the optical outgoing radiation side of a circular polarization of light detached core, it is [the arrangement location] more desirable than the point which controls color change of the outgoing radiation light by viewing-angle change that it is a side with the main large wavelength of the reflected light in the cholesteric-liquid-crystal polymer layer of a circular polarization of light detached core (long wave merit side). Although the thickness of a quarter-wave length plate can be suitably determined according to the phase contrast etc., it is more desirable than points, such as flexibility and thin-shape-izing, that the overall thickness of a polarizing element is adjusted so that 10-400-micrometer 2-500 micrometers may become the thickness of 20-300 micrometers especially above all.

[0048] The polarizing element of this invention can arrange one sort of a diffusion layer 3 or the proper optical layer of polarizing plate 4 grade, or two sorts or more to swerve, as illustrated to drawing 3 , and it can form them in various gestalten. A polarizing plate 4 is arranged above the quarter-wave length plate 2 like the example of drawing from the function of the above-mentioned quarter-wave length plate.

[0049] As for the arrangement angle over the quarter-wave length plate of a polarizing plate, it is more desirable than points, such as improvement in brightness, that the transparency shaft is as much as possible in agreement with the plane of vibration of the linearly polarized light which penetrated the quarter-wave length plate. In addition, in the case of the polarizing element of the gestalt which prepared the polarizing plate, the polarizing plate prepared in the light source side of a liquid crystal cell is omissible.

[0050] Although a proper thing can be used as a polarizing plate, generally what consists of a polarization film is used. As an example of a polarization film, the polyene oriented film like a thing, the dehydration processing object of polyvinyl alcohol, or the demineralization acid-treatment object of a polyvinyl chloride which iodine and/or dichromatic dye were made to stick to the film of the hydrophilic giant molecule like a polyvinyl alcohol system, a partial formal-ized polyvinyl alcohol system, and an ethylene-vinylacetate copolymer system partial saponification object, and was extended is raised.

[0051] Although the thickness of a polarization film is 5-80 micrometers usually, it is not limited to this. A polarizing plate may be what covered one side or both sides of a polarization film with transparent protection layer etc. This transparent protection layer etc. may have the various objects, such as

protecting reinforcement of a polarization film, heat-resistant improvement, and a polarization film from humidity etc. Transparent protection layer can be formed as the spreading layer of resin, a lamination layer of a resin film, etc., and may contain the particles diffusion-izing, for surface roughening, etc.

[0052] The diffusion layer prepared in a polarizing element if needed equalizes outgoing radiation light, controls light-and-darkness nonuniformity, and when it applies to a liquid crystal cell etc., it aims at prevention of the check by looking [GIRAGIRA / check by looking] by moire arising in interference with a pixel etc. the vertical-incidence light whose phase contrast of the diffusion layer which can be used more preferably than points, such as the maintenance nature of the polarization condition of the light which carried out outgoing radiation from the circular polarization of light detached core or the quarter-wave length plate, is the wavelength of 633nm -- based on the incident light of less than 30 incident angles, 30nm or less is a 0-20nm thing above all preferably.

[0053] Diffusion layers are methods with arbitrary craze generating method by the method by surface irregularity-ized processing of the formation method of for example, a particle distribution resin layer, sandblasting, chemical etching, etc., mechanical stress, solvent processing, etc., imprint formation method by the metal mold which established predetermined diffusion structure, etc., and can be suitably formed as a spreading layer, a diffusion sheet, etc. to a circular polarization of light detached core, a quarter-wave length plate, etc. A diffusion layer can arrange one layer or more than two-layer in the proper location contiguous to circular polarization of light detached cores and quarter-wave length plates, such as one side of a circular polarization of light detached core, both sides, and between a quarter-wave length plate and polarizing plates, those top faces, a polarizing plate, etc.

[0054] The polarizing element by this invention can be preferably used for formation of polarization light equipment or a liquid crystal display etc. The example was illustrated to drawing 4 . Drawing shows the liquid crystal display 6 and 5 is polarization light equipment.

[0055] According to the aforementioned polarization light equipment 5, while the light which carried out outgoing radiation from the light guide plate carries out incidence of the incident light from a side face to the circular polarization of light detached core 1 arranged to the outgoing radiation side side of the light guide plate 51 which carries out outgoing radiation and the circular polarization of light of the method of left Uichi penetrates it from one side of a vertical side, the circular polarization of light of another side is reflected, and re-incidence of the reflected light is carried out to a light guide plate as a return light. It is reflected in the reflex function part which consists of reflecting layer 52 grade at the bottom, and incidence of the light which carried out re-incidence to the light guide plate is again carried out to the circular polarization of light division plate 1, and it is again divided into the transmitted light and the reflected light (third-time incident light).

[0056] Therefore, although the re-incident light as said reflected light will be shut up between a circular polarization of light detached core and a light guide plate and will repeat an echo until it turns into the predetermined circular polarization of light which may penetrate a circular polarization of light detached core, in this invention, it is a small number of cycles as much as possible, and the thing of an echo of first-time re-incident light which was made to carry out outgoing radiation repeatedly that there is nothing is more desirable [incident light] than points, such as utilization effectiveness of re-incident light, above all.

[0057] As the aforementioned light guide plate, the proper thing which carries out outgoing radiation of the incident light from a side face from one side of a vertical side can be used. This light guide plate can be obtained as what prepared diffuser in transparence, the optical outgoing radiation side of a translucent resin plate, or its rear face the shape of a dot, and in the shape of a stripe, a thing which gave concavo-convex structure and the concavo-convex structure which consists of a detailed prism array above all to the rear face of a resin plate.

[0058] Therefore, a light guide plate consists of a tabular object which has the vertical side where one side serves as an outgoing radiation side, and the plane of incidence between vertical sides which consists of a 1 side-edge side at least usually. When the light source 53 of the linear light source of a cathode-ray tube etc., light emitting diode, etc. is allotted to a side face and incidence of the light source light is carried out like drawing 4 (the cold, heat), the light guide plate 51 in a well-known side light mold back light etc. is the example in the liquid crystal display which was made to carry out outgoing radiation of the light transmitted in the inside of a plate to the one side side of a plate by diffusion, an echo and diffraction, interference, etc.

[0059] The light guide plate which can use preferably than the point to which the return circuit light which led to the underside the circular polarization of light which carried out re-incidence through the circular polarization of light detached core, phase contrast being uninfluential and maintaining the circular polarization of light condition good, and was reflected on the underside is made to come out of

and put, with the circular polarization of light condition maintained is as much as possible small like the diffusion layer which the phase contrast by the birefringence in the thickness direction described above, and is a 0-20-nm thing especially 30 nm or less above all.

[0060] While described above, and although the light guide plate which carries out outgoing radiation of the light to a field side may have the function which carries out polarization conversion of the light reflected by the circular polarization of light detached core by itself, it can prevent a reflective loss nearly thoroughly by forming a reflecting layer 52 in the rear face of a light guide plate. Reflecting layers, such as a diffuse reflection layer and a specular reflection layer, are excellent in the function which carries out polarization conversion of the light reflected by the circular polarization of light detached core, and desirable in this invention.

[0061] Based on the diffusion, a polarization condition is intermingled at random and the diffuse reflection layer incidentally represented with a concavo-convex field etc. cancels a polarization condition substantially. Moreover, if the circular polarization of light is reflected, the polarization condition will reverse the specular reflection layer represented with the metal side which consists of vacuum evaporationo layers, such as aluminum and silver, a resin plate which prepared it, a metallic foil, etc.

[0062] Auxiliary means, such as the light source holder 54 for leading the reflective means for returning the diffusion plate for obtaining the prism sheet for controlling the direction of outgoing radiation of light and uniform luminescence on the occasion of formation of a light guide plate and leakage light and the outgoing radiation light from a linear light source to the side face of a light guide plate, are arranged one layer or more than two-layer in a predetermined location if needed, and it considers as a proper combination object.

[0063] In addition, when arranging the prism sheet more than two-layer, it is more desirable than points, such as equalization of the brightness by control of the direction of optical outgoing radiation in the whole field, to arrange so that the array direction of a prism array may cross in an up-and-down layer. The dot given to the prism sheet arranged to the optical outgoing radiation side of a light guide plate, the diffusion plate, or the light guide plate may function as a polarization conversion means to change the phase of the reflected light by a spreading effect etc.

[0064] The liquid crystal display 6 of the instantiation to drawing 4 uses the above-mentioned polarization light equipment 5 for a back light system, and, for a lower polarizing plate and 61, a liquid crystal cell and 62 are [4 / an upper polarizing plate and 63] diffusion plates. A lower polarizing plate 4 and the lower diffusion plate 63 are formed if needed. The polarization light equipment using the polarizing element by this invention is excellent in the utilization effectiveness of light, offers a bright light, and forms the liquid crystal display which large-area-izing etc. is easy, is bright, and is excellent in visibility.

[0065] Generally a liquid crystal display is formed as an assembly of component parts, such as a driving gear of accompanying in the liquid crystal cell and it which function as a liquid crystal shutter, a polarizing plate, a back light, and a phase contrast plate for compensation as occasion demands, etc. In this invention, except for the point using the polarization light equipment by the above-mentioned polarizing element, there is especially no definition, it can be formed according to the former, and can form preferably especially the liquid crystal display of a direct viewing type.

[0066] Therefore, there is especially no definition about the liquid crystal cell to be used, and a proper thing can be used. Although it is used in favor of what displays above all by carrying out incidence of the light of a polarization condition to a liquid crystal cell, for example, can use for the liquid crystal cell using a twist nematic liquid crystal or a super twist nematic liquid crystal etc. preferably, the liquid crystal and dichromatic dye of a non-twisting system can be used for the liquid crystal cell using the liquid crystal of the guest host system distributed in liquid crystal, or a ferroelectric liquid crystal etc. There is especially no definition also about the actuation method of liquid crystal.

[0067] On the occasion of formation of a liquid crystal display, proper optical layers, such as a diffusion plate formed, for example on the polarizing plate by the side of a check by looking, an anti glare layer, an antireflection film and a protective layer, a guard plate, or a phase contrast plate for compensation formed between a liquid crystal cell and a polarizing plate, can be arranged suitably.

[0068] The aforementioned phase contrast plate for compensation aims at compensating the wavelength dependency of a birefringence etc. and aiming at improvement in visibility etc. In this invention, it is arranged if needed between the polarizing plate by the side of a check by looking or/and a back light, and a liquid crystal cell etc. In addition, as a phase contrast plate for compensation, a proper thing can be used according to a wavelength region etc., and it may be formed as a superposition layer more than one layer or two-layer. The phase contrast plate for compensation can be obtained as an oriented film of instantiation etc. with the above-mentioned quarter-wave length plate.

[0069] in this invention, laminating unification is carried out on the whole or selectively, and the components which form the above-mentioned polarizing element and polarization light equipment, and a liquid crystal display fix -- having -- **** -- separation -- you may arrange in the easy condition. Having fixed is more desirable than points, such as gap prevention of optical system. Although proper adhesives can be used for the fixing, rather than points, such as generating prevention of the optical strain by heat, a binder can use preferably.

[0070] In addition, on the occasion of formation of a liquid crystal display etc., the outgoing radiation light which is excellent in perpendicularity or Yukimitsu Taira nature is supplied, the re-incident light through a circular polarization of light detached core is also in a condition with little the loss and include-angle change by dispersion etc., and the conformity of the direction of initial outgoing radiation light improves re-outgoing radiation, and the polarization light equipment which supplies efficiently the outgoing radiation light of a direction effective in improvement in visibility can use preferably.

[0071]

[Example] To the polyvinyl alcohol rubbing processing side (0.1 micrometers in thickness) of a triacetic-acid cellulose film with an example 1 thickness of 50 micrometers The 20-% of the weight tetrahydrofuran solution of an acrylic thermotropic cholesteric-liquid-crystal polymer by the cooled method which carries out heating orientation processing for 5 minutes at 160 degrees C after membrane formation with a spin coat method Two sorts of circular polarization of light detached cores to which 2 micrometers in thickness and the main wavelength of selective reflection penetrate the left-handed circularly-polarized light by 500nm or 600nm are obtained. After pasting up the liquid crystal polymer layers through an acrylic adhesive layer, the quarter-wave length plate of 115nm of phase contrast with which the main wavelength of the selective reflection consists of a polycarbonate through an acrylic adhesive layer on the cholesteric-liquid-crystal polymer layer which is 600nm was pasted up, and the polarizing element was obtained. The lagging axis of a quarter-wave length plate and the crossed axes angle of the molecular orientation shaft (the direction of rubbing) of the cholesteric-liquid-crystal polymer layer front face whose main wavelength of selective reflection is 600nm were made into 90 degrees at that time.

[0072] The crossed axes angle of the lagging axis of example 21 / 4 wavelength plate and the molecular orientation shaft of a liquid crystal polymer layer was made into 135 degrees, and also the polarizing element was obtained according to the example 1.

[0073] The crossed axes angle of the lagging axis of example 31 / 4 wavelength plate and the molecular orientation shaft of a liquid crystal polymer layer was made into 180 degrees, and also the polarizing element was obtained according to the example 1.

[0074] The crossed axes angle of the lagging axis of the example quarter-wave length plate of a comparison and the molecular orientation shaft of a liquid crystal polymer layer was made into 45 degrees, and also the polarizing element was obtained according to the example 1.

[0075] The transparency shaft was made in agreement with the plane of vibration of the linearly polarized light which minded the quarter-wave length plate on the quarter-wave length plate of the polarizing element obtained in the assessment trial example and the example of a comparison, the polarizing plate (43% of permeability, 99.9% of degree of polarization) has been arranged, it has been arranged on the surface light source, and the spectrophotometer (the Murakami Color Research Laboratory make, CMS-500) investigated the permeability and hue change (**ab) on a polarizing plate. In addition, hue change computed the hue in the case of depending the hue of a criteria polarizing plate on the polarizing element by a0, b0, said example, and the example of a comparison from the degree type as a1 and b1.

**ab=root {(a0-a1) + (b0-b1)}

[0076] The aforementioned result was shown in degree table.

	実施例1	実施例2	実施例3	比較例
透過率（%）	38．4	38．6	38．4	37．8
色相変化	1．2	1．3	1．6	2．1

[Brief Description of the Drawings]

[Drawing 1] The explanatory view of a polarizing element

[Drawing 2] The sectional view of other examples of a polarizing element
[Drawing 3] The sectional view of the example of a polarizing element of further others
[Drawing 4] The sectional view of polarization light equipment and the example of a liquid crystal display
[Description of Notations]
1: Circular polarization of light detached core
11, 13, 15: Support base material
12 14: Cholesteric-liquid-crystal polymer layer
2:1/4 wavelength plate
21 22: Phase contrast layer
3: Diffusion layer
4: Polarizing plate
5: Polarization light equipment
51: Light guide plate
52: Reflecting layer
53: Light source
6: Liquid crystal display

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		５３０			５３０

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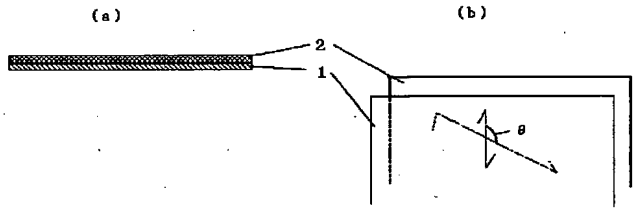
(54)【発明の名称】　偏光素子、偏光光源装置及び液晶表示装置

(57)【要約】

【課題】　輝度とその安定性に優れる偏光素子の開発。

【解決手段】　１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層（１）の上に少なくとも１／４波長板（２）を有してなり、その円偏光分離層における１／４波長板側のコレステリック液晶ポリマー層の表面における平均分子配向方向と１／４波長板における遅相軸方向が９０～１８０度の交差状態にある偏光素子、及び側面からの入射光を上下面の一方より出射する導光板の出射面側に前記の偏光素子を有する偏光光源装置、並びに液晶セルの片側にその偏光光源装置を配置した液晶表示装置。

【効果】　１／４波長板を介して偏光度が高く、色変化が小さい直線偏光が変換効率よく得られ、光利用効率に優れて輝度に優れる偏光光源装置、ひいては明るくて表示ムラが小さく視認性に優れる液晶表示装置を形成できる。



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【特許請求の範囲】

【請求項１】　１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層の上に少なくとも１／４波長板を有してなり、その円偏光分離層における１／４波長板側のコレステリック液晶ポリマー層の表面における平均分子配向方向と１／４波長板における遅相軸方向が９０～１８０度の交差状態にあることを特徴とする偏光素子。

【請求項２】　請求項１において、１／４波長板側のコレステリック液晶ポリマー層の表面における分子配向方向が略一方向に揃ったものである偏光素子。

【請求項３】　請求項１又は２において、円偏光分離層における反射光の中心波長の大きい側に１／４波長板が位置する偏光素子。

【請求項４】　請求項１～３において、反射光の中心波長が４００～５５０nm未満のコレステリック液晶ポリマーと５５０以上～７００nmのコレステリック液晶ポリマーにて円偏光分離層が形成されてなる偏光素子。

【請求項５】　請求項１～４において、コレステリック液晶ポリマー層の合計厚が１～５０μmで、全厚が２～５００μmである偏光素子。

【請求項６】　請求項１～５において、円偏光分離層が厚さ方向に螺旋ピッチが変化するコレステリック液晶ポリマー層からなる偏光素子。

【請求項７】　請求項１～６において、１／４波長板の上方に偏光板を有する偏光素子。

【請求項８】　側面からの入射光を上下面の一方より出射する導光板の出射面側に請求項１～７に記載の偏光素子を有することを特徴とする偏光光源装置。

【請求項９】　液晶セルの片側に、請求項８に記載の偏光光源装置を配置したことを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の技術分野】本発明は、光利用効率に優れる偏光光源装置や明るさに優れて良視認性の液晶表示装置等を形成しうる偏光素子に関する。

【０００２】

【背景技術】従来、側面からの入射光を上下面の片側より出射させるようにしたサイドライト型の導光板の下面に反射層を設け、出射面にコレステリック液晶層からなる円偏光分離層を設けて、その円偏光分離層を介し入射光を左右の円偏光からなる透過光と反射光に分離し、その反射光を下面の反射層を介し反射させて出射面より再出射させるようにした照明システムが提案されていた（特開平３－４５９０６号公報、特開平６－３２４３３３号公報、特開平７－３６０３２号公報）。

【０００３】かかる照明システムは、非偏光の通例光では偏光板を透過する際に導光板出射光の５５％程度が吸収されて有効利用できる光に乏しいことから、光を偏光として供給できるようにして偏光板による吸収を防止

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し、それにより光利用効率の向上をはかって液晶表示装置等の明るさを向上させうるようにしたものである。

【０００４】前記において、円偏光分離層の出射円偏光に対しては、１／４波長板を透過させて直線偏光化することで偏光板による吸収をより低減でき、透過率の向上を図りうる。従って液晶表示装置等には、円偏光分離層に１／４波長板を付設して偏光素子としたものが好ましく用いうる。

【０００５】しかしながら、円偏光分離層に１／４波長板を配置した場合に輝度のバラツキを生じる問題点があった。

【０００６】

【発明の技術的課題】本発明者らは、前記の問題点を克服するために鋭意研究を重ねる中で、円偏光分離層の配向方向と１／４波長板の光学軸が輝度のバラツキに関係のあることを究明した。従って本発明は、輝度とその安定性に優れる偏光素子の開発を課題とする。

【０００７】

【課題の解決手段】本発明は、１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層の上に少なくとも１／４波長板を有してなり、その円偏光分離層における１／４波長板側のコレステリック液晶ポリマー層の表面における平均分子配向方向と１／４波長板における遅相軸方向が９０～１８０度の交差状態にあることを特徴とする偏光素子、及び側面からの入射光を上下面の一方より出射する導光板の出射面側に前記の偏光素子を有することを特徴とする偏光光源装置、並びに液晶セルの片側にその偏光光源装置を配置したことを特徴とする液晶表示装置を提供するものである。

【０００８】

【発明の効果】本発明の偏光素子によれば、１／４波長板を介して偏光度が高く、色変化が小さい直線偏光を変換効率よく得ることができる。その結果、それを用いて光利用効率に優れて輝度に優れる偏光光源装置、ひいては明るくて表示ムラが小さく視認性に優れる液晶表示装置を形成することができる。

【０００９】

【発明の実施形態】本発明の偏光素子は、１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層の上に少なくとも１／４波長板を有してなり、その円偏光分離層における１／４波長板側のコレステリック液晶ポリマー層の表面における平均分子配向方向と１／４波長板における遅相軸方向が９０～１８０度の交差状態にあるものからなる。その例を図１、図２に示した。１が円偏光分離層、２が１／４波長板であり、１１，１３，１５は支持基材、１２，１４はコレステリック液晶ポリマー層である。

【００１０】円偏光分離層は、グランジャン配向により自然光を透過光と反射光として左右の円偏光に分離する適宜なコレステリック液晶ポリマーの１種又は２種以上

を用いて形成しうる。従ってコレステリック液晶ポリマーとしては、液晶配向性を付与する共役性の直線状原子団（メソゲン）がポリマーの主鎖や側鎖に導入された主鎖型や側鎖型などの種々のものを用いうる。

【００１１】位相差の大きいコレステリック液晶ポリマーほど選択反射の波長域が広くなり、大視野角時の波長シフトに対する余裕などの点より好ましく用いうる。また液晶ポリマーとしては、取扱い性や実用温度での配向の安定性などの点より、ガラス転移温度が３０～１５０℃のものが好ましく用いうる。

【００１２】ちなみに前記した主鎖型の液晶ポリマーの例としては、屈曲性を付与するスペーサ部を必要に応じ介してパラ置換環状化合物等からなるメソゲン基を結合した構造を有する、例えばポリエステル系やポリアミド系、ポリカーボネート系やポリエステルイミド系などのポリマーがあげられる。

【００１３】また側鎖型の液晶ポリマーの例としては、ポリアクリレートやポリメタクリレート、ポリシロキサンやポリマロネート等を主鎖骨格とし、側鎖として共役性の原子団からなるスペーサ部を必要に応じ介してパラ置換環状化合物等からなる低分子液晶化合物（メソゲン部）を有するもの、低分子カイラル剤含有のネマチック系液晶ポリマー、キラル成分導入の液晶ポリマー、ネマチック系とコレステリック系の混合液晶ポリマーなどがあげられる。

【００１４】前記の如く、例えばアゾメチン形やアゾ形、アゾキシ形やエステル形、ビフェニル形やフェニルシクロヘキサン形、ビシクロヘキサン形の如きパラ置換芳香族単位やパラ置換シクロヘキシル環単位などからなるネマチック配向性を付与するパラ置換環状化合物を有するものにても、不斉炭素を有する化合物等からなる適宜なキラル成分や低分子カイラル剤等を導入する方式などによりコレステリック配向性のものとすることができる（特開昭５５－２１４７９号公報、米国特許明細書第５３３２５２２号等）。なおパラ置換環状化合物におけるパラ位における末端置換基は、例えばシアノ基やアルキル基、アルコキシ基などの適宜なものであってよい。

【００１５】またスペーサ部としては、屈曲性を示す例えばポリメチレン鎖－（CH_2）$_n$－やポリオキシメチレン鎖－（CH_2CH_2O）$_m$－などがあげられる。スペーサ部を形成する構造単位の繰返し数は、メソゲン部の化学構造等により適宜に決定され、一般にはポリメチレン鎖の場合にはｎが０～２０、就中２～１２、ポリオキシメチレン鎖の場合にはｍが０～１０、就中１～３である。

【００１６】円偏光分離層の形成は、例えば支持基材上にポリイミドやポリビニルアルコール、ポリエステルやポリアリレート、ポリアミドイミドやポリエーテルイミド等の膜を形成してレーヨン布等でラビング処理した配向膜、又はSiO_2の斜方蒸着層等からなる適宜な配向膜を設けてその配向膜の上に、あるいは延伸フィルム等からなる分子配向性の支持基材の上にコレステリック液晶ポリマーを展開し、それをガラス転移温度以上、等方相転移温度未満に加熱し、液晶ポリマー分子がグランジャン配向した状態でガラス転移温度未満に冷却してガラス状態とし、当該配向が固定化された固化層とする方法などにより行うことができる。

【００１７】前記の支持基材には、透明なプラスチックフィルムやガラス板などからなる単層物や複層物等の適宜なものを用いうる。そのプラスチックについては特に限定はなく、耐湿性や耐熱性や強度等の使用目的に応じた物性などにより適宜に選択することができる。ちなみに前記プラスチックの例としては、ポリエチレンやポリプロピレンの如きポリオレフィン系、ポリエステル系、ポリイミド系、ポリカーボネート系、ポリエーテルスルホン系、ポリスルホン系、セルロース系、ポリアリレート系、ポリスチレン系、ポリビニルアルコール系、ポリ塩化ビニル系、ポリ塩化ビニリデン系、ポリアクリル系、ポリアミド系、エポキシ系、液晶ポリマー系のものなどがあげられる。

【００１８】液晶ポリマーの展開は、例えば液晶ポリマーの溶媒による溶液をスピンコート法やロールコート法、フローコート法やプリント法、ディップコート法や流延成膜法、バーコート法やグラビア印刷法等の適宜な方法で薄層展開し、それを必要に応じ乾燥処理する方法などにより行うことができる。前記の溶媒としては、例えば塩化メチレンやシクロヘキサノン、トリクロロエチレンやテトラクロロエタン、Ｎ－メチルピロリドンやテトラヒドロフランなどの適宜なものを用いうる。

【００１９】また液晶ポリマーの加熱溶融物、好ましくは等方相を呈する状態の加熱溶融物を前記に準じ展開し、必要に応じその溶融温度を維持しつつ更に薄層に展開して固化させる方法などの、溶媒を使用しない方法、従って作業環境の衛生性等が良好な方法によっても液晶ポリマーを展開させることができる。

【００２０】液晶ポリマーの展開層を配向させるための加熱処理は、上記した如く液晶ポリマーのガラス転移温度から等方相転移温度までの温度範囲、すなわち液晶ポリマーが液晶相を呈する温度範囲に加熱することにより行うことができる。また配向状態の固定化は、ガラス転移温度未満に冷却することで行うことができ、その冷却条件については特に限定はない。通例、前記の加熱処理を３００℃以下の温度で行いうることから、自然冷却方式が一般に採られる。

【００２１】形成するコレステリック液晶ポリマー層は、可及的に均一に配向していることが好ましい。特に本発明にては１／４波長板の配置状態がそれを設ける側のコレステリック液晶ポリマー層の表面における分子配向方向に規制されるため、液晶ポリマーの配向が可及的に均一であること、就中少なくとも前記の表面において

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一方向に均一性よく揃っていることが好ましい。均一配向のコレステリック液晶ポリマー層は、散乱のない反射光を提供して、液晶表示装置等の視野角の拡大に有利であり、特に斜め方向からも直接観察される直視型液晶表示装置等の形成に適している。

【００２２】支持基材の片面又は両面上に形成したコレステリック液晶ポリマー層は、その支持基材に付設したまま、あるいは支持基材より分離して円偏光分離層の形成に用いうる。また円偏光分離層を形成するコレステリック液晶ポリマー層は、１層であってもよいし、２層以上であってもよい。従って本発明の偏光素子は、図１（ａ）や図２（ａ）～（ｈ）に例示した如く、１層又は２層以上のコレステリック液晶ポリマー層１，１２，１４の適宜な位置に、単層若しくは複層の支持基材１１，１３，１５を有する形態又は支持基材を有しない形態の適宜な層形態を有するものであってよい。

【００２３】前記において２層以上のコレステリック液晶ポリマー層の配置による円偏光分離層の形成は、反射波長域の拡大等を目的とする。すなわち単層のコレステリック液晶ポリマー層では通例、選択反射性（円偏光二色性）を示す波長域に限界があり、その限界は約１００nmの波長域に及ぶ広い範囲の場合もあるが、その波長範囲でも例えば液晶表示装置等に適用する場合に望まれる可視光の全域には及ばないから、選択反射性（反射波長域）の異なる２層以上のコレステリック液晶ポリマー層を設けて可視光域の全域ないし可及的に全域を反射波長域とする場合などの如く、円偏光二色性を示す波長域を拡大させることを目的とする。ちなみに選択反射の中心波長が３００～９００nmのコレステリック液晶ポリマー層を同じ偏光方向の円偏光を反射する組合せで、かつ選択反射の中心波長が異なる組合せで用いて、その２～６種類を重畳することで可視光域をカバーできる円偏光分離層を効率的に形成することができる。

【００２４】円偏光分離層の薄型化等の点よりは、コレステリック液晶ポリマー層の可及的に少ない配置数、就中２層の配置数で目的の反射波長域を示すものが好ましい。ちなみに可視光域では、反射光の中心波長が４００～５５０nm未満と５５０以上～７００nmの範囲にある２層のコレステリック液晶ポリマー層の配置でその全域ないし可及的に全域を反射波長域とする円偏光分離層を得ることができ、そのより好ましい組合せは、反射光の中心波長が４５０～５４０nm、就中４８０～５２０nmの範囲、特に約５００nmのものと、５６０～６５０nm、就中５８０～６２０nmの範囲、特に約６００nmのものとの２層である。

【００２５】前記した２層のコレステリック液晶ポリマー層の組合せは、視角変化、すなわち斜め透過光の出射角度による色変化が小さい利点なども有している。なお反射波長域の異なる３層以上のコレステリック液晶ポリマー層を設ける場合には、反射光の中心波長の長短に基

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づく波長順序に配置することが、前記視角変化による出射光の色変化を抑制する点などより好ましい。

【００２６】なお前記した２層以上のコレステリック液晶ポリマー層を配置する場合に、同じ偏光方向の円偏光を反射するものの組合せとする点は、各層で反射される円偏光の位相状態を揃えて各波長域で異なる偏光状態となることを防止し、利用できる状態の偏光の増量を目的とする。

【００２７】前記したコレステリック液晶ポリマーにおける反射光の中心波長の相違は、クランジャン配向の螺旋ピッチの相違に基づくが、本発明にては厚さ方向に螺旋ピッチが変化する円偏光分離層や、螺旋ピッチ相違の２層以上のコレステリック液晶ポリマー層が反射光の中心波長に基づいて長短の順序通りに重畳して厚さ方向に螺旋ピッチが変化する円偏光分離層などの適宜な形態の円偏光分離層であってよい。

【００２８】前記した螺旋ピッチが厚さ方向に変化する構造も反射光の波長域の拡大などに有効である。その場合、同じ螺旋ピッチのコレステリック液晶ポリマー層間に、螺旋ピッチの異なるコレステリック液晶ポリマー層が前記中心波長の長短の順序通りに１層又は２層以上介在した形態のものの如く、同じ螺旋ピッチのコレステリック液晶ポリマー層を２層以上含む層構造なども許容される。

【００２９】なお上記した螺旋ピッチが厚さ方向に変化する円偏光分離層の製造は、例えば配向処理したコレステリック液晶ポリマー層の上に、上記したコレステリック液晶ポリマー層の形成操作に準じて、液晶ポリマーの展開及びその加熱配向処理を行うことによりコレステリック液晶ポリマー層を順次重畳する方式や、配向処理したコレステリック液晶ポリマー層同士の２枚又は３枚以上の所定数を熱圧着により接着する操作などにより行うことができる。

【００３０】基材との一体物からなる液晶ポリマーの固化層の場合には、その固化層同士が密接するように前記に準じて重畳処理することにより厚さ方向に螺旋ピッチが変化する円偏光分離層、ひいては本発明による偏光素子を得ることができる。なお熱圧着処理には、ロールラミネータ等の適宜な加熱押圧手段を介してコレステリック液晶ポリマー層をガラス転移温度以上、等方相転移温度未満に加熱して圧着処理する方式などの適宜な方式を採ることができる。

【００３１】厚さ方向に螺旋ピッチが変化する円偏光分離層は、連続した反射光の波長域を示すものであってもよいし、不連続な反射光の波長域を示すものであってもよい。色ムラ防止等の点より好ましい円偏光分離層は、連続した反射光の波長域を示すものである。その製造は、例えば上記した熱圧着操作等で形成したコレステリック液晶ポリマー層の重畳体をガラス転移温度以上、等方相転移温度未満に加熱して、その密着界面に上下の層

を形成するコレステリック液晶ポリマーが混合した配向層を形成する方法などにより行うことができる。

【００３２】前記において、上下の層のコレステリック液晶ポリマーが混合して形成されたコレステリック液晶ポリマー層は、螺旋ピッチが上下の層とも異なって厚さ方向に螺旋ピッチが多段階に変化した円偏光分離層を形成し、通例その螺旋ピッチは上下の層を形成するコレステリック液晶ポリマー層の中間値をとって、上下の層と共に連続した反射光の波長域を示す領域を形成する。

【００３３】従って上下の層で反射光の波長域が重複しないコレステリック液晶ポリマー層の組合せ、すなわち反射光の波長域に不連続による欠落域が存在する組合せで用いた場合に、上下の層の混合により形成されたコレステリック液晶ポリマー層が前記欠落域を埋めて反射光の波長域を連続化することができる。

【００３４】よって例えば、反射波長域が５００nm以下のものと６００nm以上のものの２種のコレステリック液晶ポリマー層を用いて、反射波長域の不連続域である５００～６００nmの波長域の光についても反射する円偏光分離層を得ることができ、これは少ないコレステリック液晶ポリマー層の重畳で、広い帯域の反射波長域を示す円偏光分離層を形成しうることを意味する。

【００３５】各コレステリック液晶ポリマー層の厚さは、配向の乱れや透過率低下の防止、反射光の波長範囲（反射波長域）の広さなどの点より、０．５～５０μm、就中１～３０μm、特に１．５～１０μmが好ましい。また円偏光分離層の薄型化等の点よりコレステリック液晶ポリマー層の合計厚が１～５０μm、就中２～３０μm、特に３～１０μmであることが好ましい。

【００３６】さらに支持基材を含めたコレステリック液晶ポリマー層の合計厚は、２～４９０μm、就中１０～３００μm、特に２０～２００μmであることが好ましい。なお円偏光分離層の形成に際しては、コレステリック液晶ポリマー層に安定剤や可塑剤、あるいは金属類などからなる種々の添加剤を必要に応じて配合することができる。

【００３７】本発明による偏光素子は、図例の如く円偏光分離層１の上方に少なくとも１／４波長板２を有するものであり、図１（ｂ）に矢印で示した如くその円偏光分離層における１／４波長板側のコレステリック液晶ポリマー層の表面における平均分子配向方向と１／４波長板における遅相軸方向が９０～１８０度の交差状態にあるものである。輝度や色ムラ防止等の点より好ましい交差角θは、１００～１７０度である。

【００３８】前記の１／４波長板は、直線偏光変換手段として機能するものであり、円偏光分離層より出射した円偏光が１／４波長板に入射して位相変化を受け、その位相変化が１／４波長に相当する波長の光は直線偏光に変換され、他の波長光は楕円偏光に変換される。変換された楕円偏光は、前記の直線偏光に変換された光の波長に近いほど扁平な楕円偏光となる。かかる結果、偏光板を透過しうる直線偏光成分を多く含む状態の光が１／４波長板より出射されることとなる。

【００３９】直線偏光成分の多い状態に変換することにより、偏光板を透過しやすい光とすることができる。この偏光板は、例えば液晶表示装置の場合、液晶セルに対する視野角の変化で発生する偏光特性の低下を防止して表示品位を維持する光学層や、より高度な偏光度を実現してよりよい表示品位を達成する光学層などとして機能するものである。

【００４０】すなわち前記において、偏光板を用いずに、円偏光分離層よりの出射偏光をそのまま液晶セルに入射させて表示を達成することは可能であるが、偏光板を介することで前記した表示品位の向上等をはかりうることから必要に応じて偏光板が用いられる。その場合に、偏光板に対する透過率の高いほど表示の明るさの点より有利であり、その透過率は偏光板の偏光軸（透過軸）と一致する偏光方向の直線偏光成分を多く含むほど高くなるので、それを目的に直線偏光変換手段を介して円偏光分離層よりの出射偏光を所定の直線偏光に変換するものである。

【００４１】ちなみに、通例のヨウ素系偏光板に自然光や円偏光を入射させた場合、その透過率は約４３％程度であるが、直線偏光を偏光軸を一致させて入射させた場合には８０％を超える透過率を得ることができ、従って光の利用効率が大幅に向上して明るさに優れる液晶表示などが可能となる。またかかる偏光板では、９９．９９％に達する偏光度も達成できる。円偏光分離層の単独では、かかる高偏光度の達成は困難で、特に斜めからの入射光に対する偏光度が低下しやすい。

【００４２】１／４波長板としては、円偏光分離層より出射した円偏光を、１／４波長の位相差に相当して直線偏光を多く形成し、かつ他の波長の光を前記直線偏光と可及的にパラレルな方向に長径方向を有して直線偏光に近い扁平な楕円偏光に変換しうるものが好ましい。かかる１／４波長板により、その出射光の直線偏光方向や楕円偏光の長径方向が偏光板の透過軸と可及的に平行になるように配置して、偏光板を透過しうる直線偏光成分の多い状態の光を得ることができ、液晶表示の明るさを向上させることができる。

【００４３】１／４波長板にて付与する位相差は、円偏光分離層より出射される円偏光の波長域などに応じて適宜に決定しうる。ちなみに可視光域では波長範囲や変換効率等の点より、殆どの位相差板がその材質特性より正の複屈折の波長分散を示すものであることも加味して、その位相差が小さいもの、就中１００～１８０nm、特に１１０～１５０nmの位相差を与えるものが好ましく用いうる。

【００４４】１／４波長板は、適宜な材質で形成でき、透明で均一な位相差を与えるものが好ましく、一般には

位相差板が用いられる。また１／４波長板は、図１（ａ）や図２（ａ）に例示の如く１層又は２層以上の位相差層２１，２２の重畳層として形成することができる。１層からなる位相差層の場合には、複屈折の波長分散が小さいものほど波長毎の偏光状態の均一化をはかることができて好ましい。一方、位相差層の重畳化は、波長域における波長特性の改良に有効であり、その組合せは波長域などに応じて適宜に決定してよい。

【００４５】なお可視光域を対象に２層以上の位相差層からなる１／４波長板とする場合、上記の如く１００～１８０nmの位相差を与える層を１層以上の奇数層として含ませることが直線偏光成分の多い光を得る点より好ましい。１００～１８０nmの位相差を与える層以外の層は、通例２００nm以上の位相差を与える層、就中１／２波長の位相差を与える層で形成することが波長特性の改良等の点より好ましいが、これに限定するものではない。１／４波長板が２層以上の位相差層からなる場合、それを円偏光分離層上に配置する際の遅相軸方向は、１００～１８０nmの位相差を与える位相差層に基づく。

【００４６】前記した位相差板は、上記の支持基材で例示したプラスチックからなる延伸フィルムなどとして得ることができる。発光強度や発光色を広い視野角で均一に維持する点よりは、１／４波長板の面内における位相差の誤差が小さいほど好ましく、就中、その誤差が±１０nm以下であることが好ましい。

【００４７】１／４波長板は、円偏光分離層の光出射側に配置されるが、その配置位置は、視角変化による出射光の色変化を抑制する点などより、円偏光分離層のコレステリック液晶ポリマー層における反射光の中心波長の大きい側（長波長側）であることが好ましい。１／４波長板の厚さは、その位相差などに応じて適宜に決定しうるが、柔軟性や薄型化などの点より偏光素子の全厚が、２～５００μm、就中１０～４００μm、特に２０～３００μmの厚さとなるように調節されていることが好ましい。

【００４８】本発明の偏光素子は、図３に例示した如くそれに拡散層３や偏光板４等の適宜な光学層の１種又は２種以上を配置して、種々の形態に形成することができる。偏光板４は、上記した１／４波長板の機能より図例の如く、１／４波長板２の上方に配置される。

【００４９】偏光板の１／４波長板に対する配置角は、その透過軸が１／４波長板を透過した直線偏光の振動面に可及的に一致していることが輝度の向上等の点より好ましい。なお偏光板を設けた形態の偏光素子の場合には、液晶セルの光源側に設ける偏光板を省略することができる。

【００５０】偏光板としては、適宜なものを用いうるが一般には、偏光フィルムからなるものが用いられる。偏光フィルムの例としては、ポリビニルアルコール系や部分ホルマール化ポリビニルアルコール系、エチレン・酢酸ビニル共重合体系部分ケン化物の如き親水性高分子のフィルムにヨウ素及び／又は二色性染料を吸着させて延伸したもの、ポリビニルアルコールの脱水処理物やポリ塩化ビニルの脱塩酸処理物の如きポリエン配向フィルムなどがあげられる。

【００５１】偏光フィルムの厚さは通例５～８０μmであるが、これに限定されない。偏光板は、偏光フィルムの片面又は両面を透明保護層等で被覆したものなどであってもよい。かかる透明保護層等は、偏光フィルムの補強や耐熱性の向上、偏光フィルムを湿度等より保護することなどの種々の目的を有するものであってよい。透明保護層は、樹脂の塗布層や樹脂フィルムのラミネート層などとして形成でき、拡散化や粗面化用等の微粒子を含有していてもよい。

【００５２】偏光素子に必要に応じて設ける拡散層は、出射光を平準化して明暗ムラを抑制し、液晶セル等に適用した場合に画素との干渉でモアレによるギラギラした視認が生じることの防止などを目的とする。円偏光分離層や１／４波長板より出射した光の偏光状態の維持性などの点より好ましく用いうる拡散層は、位相差が波長６３３nmの垂直入射光、好ましくは入射角３０度以内の入射光に基づいて３０nm以下、就中０～２０nmのものである。

【００５３】拡散層は、例えば粒子分散樹脂層の形成方式、サンドブラストや化学エッチング等の表面凹凸化処理による方式、機械的ストレスや溶剤処理等によるクレイズ発生方式、所定の拡散構造を設けた金型による転写形成方式などの任意な方式で、円偏光分離層や１／４波長板等への塗布層や拡散シートなどとして適宜に形成することができる。拡散層は、円偏光分離層の片面や両面、１／４波長板と偏光板の間やそれらの上面などの、円偏光分離層や１／４波長板や偏光板等に隣接した適宜な位置に１層又は２層以上を配置することができる。

【００５４】本発明による偏光素子は、偏光光源装置や液晶表示装置の形成などに好ましく用いることができる。その例を図４に例示した。図は液晶表示装置６を示しており、５が偏光光源装置である。

【００５５】前記の偏光光源装置５によれば、側面からの入射光を上下面の一方より出射する導光板５１の出射面側に配置した円偏光分離層１に導光板より出射した光が入射し、左右一方の円偏光が透過すると共に他方の円偏光が反射され、その反射光は、戻り光として導光板に再入射する。導光板に再入射した光は、下面の反射層５２等からなる反射機能部分で反射されて再び円偏光分離板１に入射し、透過光と反射光（再々入射光）に再度分離される。

【００５６】従って前記反射光としての再入射光は、円偏光分離層を透過しうる所定の円偏光となるまで円偏光分離層と導光板との間に閉じ込められて反射を繰返すこととなるが、本発明においては再入射光の利用効率等の

点より、可及的に少ない繰返し数で、就中、初回の再入射光が反射の繰返しなく出射するようにしたものが好ましい。

【００５７】前記の導光板としては、側面からの入射光を上下面の一方より出射する適宜なものを用いうる。かかる導光板は、例えば透明又は半透明の樹脂板の光出射面又はその裏面にドット状やストライプ状に拡散体を設けたものや、樹脂板の裏面に凹凸構造、就中、微細プリズムアレイからなる凹凸構造を付与したものなどとして得ることができる。

【００５８】従って導光板は通例、一方が出射面となる上下面、及び上下面間の少なくとも一側端面からなる入射面を有する板状物からなる。図４の如く（冷，熱）陰極管等の線状光源や発光ダイオード等の光源５３を側面に配して光源光を入射させた場合に、板内を伝送される光を拡散や反射、回折や干渉等により板の片面側に出射するようにした、液晶表示装置で公知のサイドライト型バックライトなどにおける導光板５１はその例である。

【００５９】円偏光分離層を介して再入射した円偏光を位相差の影響なくその円偏光状態を良好に維持したまま下面に導き、また下面で反射した帰路光をその円偏光状態を維持したまま出射させる点などより好ましく用いうる導光板は、厚さ方向における複屈折による位相差が上記した拡散層と同様に可及的に小さいものであり、就中３０nm以下、特に０～２０nmのものである。

【００６０】前記した一方の面側に光を出射する導光板は、それ自体で円偏光分離層で反射された光を偏光変換する機能を有しうるが、導光板の裏面に反射層５２を設けることで反射ロスをほぼ完全に防止することができる。拡散反射層や鏡面反射層などの反射層は、円偏光分離層で反射された光を偏光変換する機能に優れ、本発明においては好ましい。

【００６１】ちなみに凹凸面等で代表される拡散反射層は、その拡散に基づいて偏光状態がランダムに混在し、実質的に偏光状態を解消する。またアルミニウムや銀等の蒸着層、それを設けた樹脂板、金属箔などからなる金属面で代表される鏡面反射層は、円偏光が反射されるとその偏光状態が反転する。

【００６２】導光板の形成に際しては、光の出射方向を制御するためのプリズムシート、均一な発光を得るための拡散板、漏れ光を戻すための反射手段、線状光源からの出射光を導光板の側面に導くための光源ホルダ５４などの補助手段を必要に応じ所定位置に１層又は２層以上配置して適宜な組合せ体とされる。

【００６３】なお２層以上のプリズムシートを配置する場合には、上下の層でプリズムアレイの配列方向が交差するように配置することが、面全体での光出射方向の制御による輝度の均一化などの点より好ましい。導光板の光出射側に配置したプリズムシートや拡散板、あるいは導光板に付与したドットなどは拡散効果等で反射光の位相を変化させる偏光変換手段として機能しうる。

【００６４】図４に例示の液晶表示装置６は、上記の偏光光源装置５をバックライトシステムに用いたものであり、４が下側の偏光板、６１が液晶セル、６２が上側の偏光板、６３が拡散板である。下側の偏光板４や拡散板６３は、必要に応じて設けられる。本発明による偏光素子を用いた偏光光源装置は、光の利用効率に優れて明るい光を提供し、大面積化等も容易であり、明るくて視認性に優れる液晶表示装置を形成する。

【００６５】液晶表示装置は一般に、液晶シャッタとして機能する液晶セルとそれに付随の駆動装置、偏光板、バックライト、及び必要に応じての補償用位相差板等の構成部品の組立体などとして形成される。本発明においては、上記した偏光素子による偏光光源装置を用いる点を除いて特に限定はなく、従来に準じて形成でき、特に直視型の液晶表示装置を好ましく形成しうる。

【００６６】従って用いる液晶セルについては特に限定はなく、適宜なものを用いうる。就中、偏光状態の光を液晶セルに入射させて表示を行うものに有利に用いられ、例えばツイストネマチック液晶やスーパーツイストネマチック液晶を用いた液晶セル等に好ましく用いうるが、非ツイスト系の液晶や二色性染料を液晶中に分散させたゲストホスト系の液晶、あるいは強誘電性液晶を用いた液晶セルなどにも用いうる。液晶の駆動方式についても特に限定はない。

【００６７】液晶表示装置の形成に際しては、例えば視認側の偏光板の上に設ける拡散板やアンチグレア層、反射防止膜や保護層や保護板、あるいは液晶セルと偏光板の間に設ける補償用位相差板などの適宜な光学層を適宜に配置することができる。

【００６８】前記の補償用位相差板は、複屈折の波長依存性などを補償して視認性の向上等をはかることを目的とするものである。本発明においては、視認側又は／及びバックライト側の偏光板と液晶セルの間等に必要に応じて配置される。なお補償用位相差板としては、波長域などに応じて適宜なものを用いることができ、１層又は２層以上の重畳層として形成されていてよい。補償用位相差板は、上記した１／４波長板で例示の延伸フィルムなどとして得ることができる。

【００６９】本発明において、上記した偏光素子や偏光光源装置や液晶表示装置を形成する部品は、全体的又は部分的に積層一体化されて固着されていてもよいし、分離容易な状態に配置したものであってもよい。光学系のズレ防止等の点よりは固着されていることが好ましい。その固着には、適宜な接着剤を用いうるが、熱による光学歪の発生防止などの点よりは粘着剤が好ましく用いうる。

【００７０】なお液晶表示装置等の形成に際しては、垂直性や平行光性に優れる出射光を供給し、円偏光分離層を介した再入射光も散乱等によるロスや角度変化の少な

い状態で、かつ初期出射光との方向の一致性よく再出射して、視認性の向上に有効な方向の出射光を効率よく供給する偏光光源装置が好ましく用いうる。

【００７１】

【実施例】実施例１

厚さ５０μmの三酢酸セルロースフィルムのポリビニルアルコールラビング処理面（厚さ０．１μm）に、アクリル系サーモトロピックコレステリック液晶ポリマーの２０重量%テトラヒドロフラン溶液をスピンコート方式で成膜後、１６０℃で５分間加熱配向処理して冷却する方式で、厚さ２μm、選択反射の中心波長が５００nm又は６００nmで左円偏光を透過する２種の円偏光分離層を得、その液晶ポリマー層同士をアクリル系粘着層を介し接着した後、その選択反射の中心波長が６００nmのコレステリック液晶ポリマー層の上にアクリル系粘着層を介し、ポリカーボネートからなる位相差１１５nmの１／４波長板を接着し、偏光素子を得た。その際、１／４波長板の遅相軸と選択反射の中心波長が６００nmのコレステリック液晶ポリマー層表面の分子配向軸（ラビング方向）の交差角は９０度とした。

【００７２】実施例２

１／４波長板の遅相軸と液晶ポリマー層の分子配向軸の

交差角を１３５度としたほかは実施例１に準じて偏光素子を得た。

【００７３】実施例３

１／４波長板の遅相軸と液晶ポリマー層の分子配向軸の交差角を１８０度としたほかは実施例１に準じて偏光素子を得た。

【００７４】比較例

１／４波長板の遅相軸と液晶ポリマー層の分子配向軸の交差角を４５度としたほかは実施例１に準じて偏光素子を得た。

【００７５】評価試験

実施例、比較例で得た偏光素子の１／４波長板の上に、その１／４波長板を介した直線偏光の振動面に透過軸を一致させて偏光板（透過率４３%、偏光度９９．９%）を配置し、それを面光源上に配置して分光光度計（村上色彩技術研究所製、ＣＭＳ－５００）にて偏光板上における透過率と色相変化（△ａｂ）を調べた。なお色相変化は、基準偏光板の色相をa_0、b_0、前記実施例、比較例による偏光素子による場合の色相をa_1、b_1として次式より算出した。

$$\triangle ab=\sqrt{\{(a_0-a_1)+(b_0-b_1)\}}$$

【００７６】前記の結果を次表に示した。

	実施例１	実施例２	実施例３	比較例
透過率（%）	３８．４	３８．６	３８．４	３７．８
色相変化	１．２	１．３	１．６	２．１

【図面の簡単な説明】

【図１】偏光素子の説明図

【図２】他の偏光素子例の断面図

【図３】さらに他の偏光素子例の断面図

【図４】偏光光源装置及び液晶表示装置例の断面図

【符号の説明】

１：円偏光分離層

１１，１３，１５：支持基材

１２，１４：コレステリック液晶ポリマー層

２：１／４波長板

２１，２２：位相差層

３：拡散層

４：偏光板

５：偏光光源装置

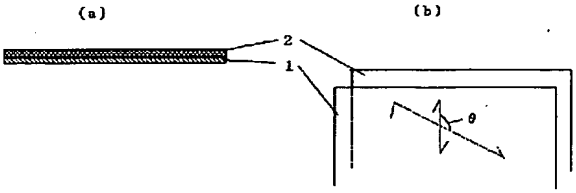
５１：導光板

５２：反射層

５３：光源

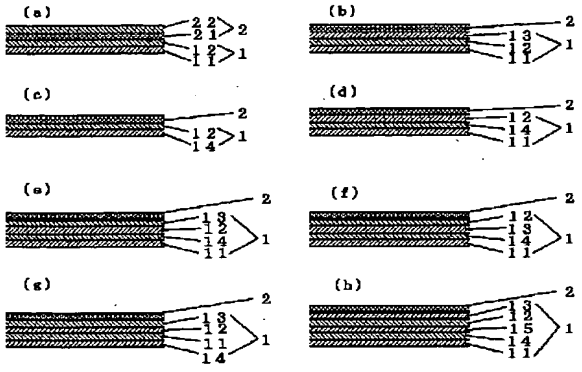
６：液晶表示装置

【図１】

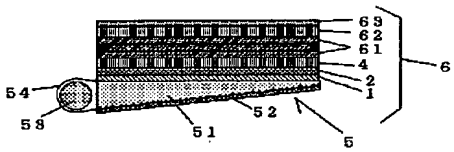


【図３】

【図２】



【図４】



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